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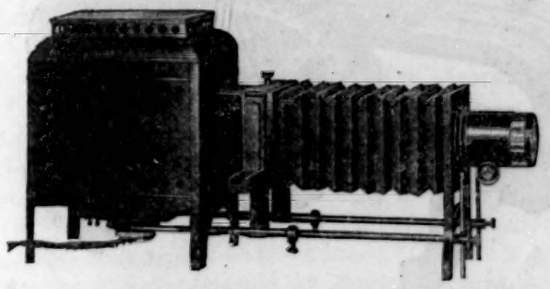

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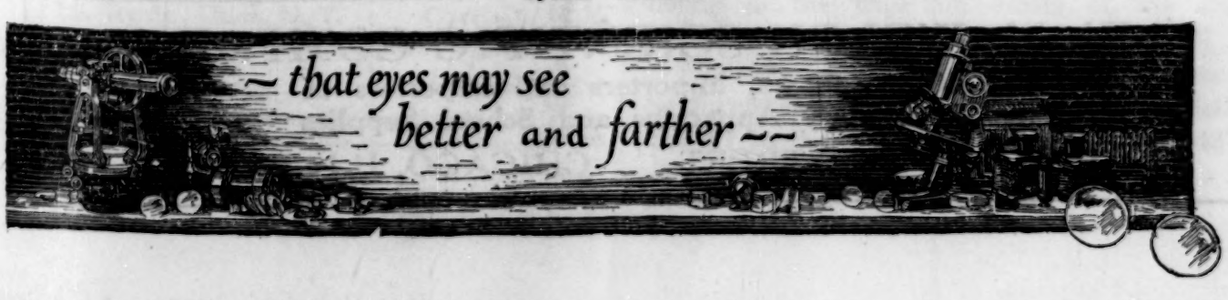

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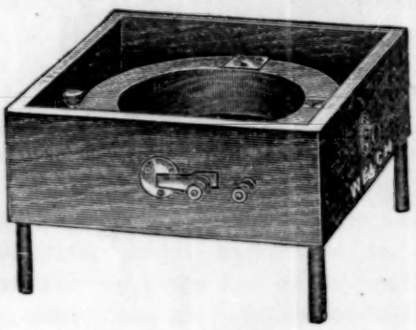

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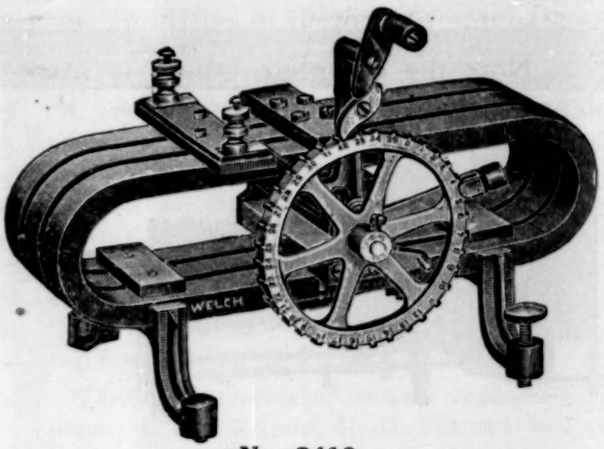

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SCIENCE

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CHANGES OF LATITUDE

IN this era of changes of every description, the question of changes of position of our astronomical observing stations on the surface of the earth has recently become a live issue. The question is still an open one, and its ultimate decision may rest upon a comparison of the precision of the results of observation with the size of the changes predicted or adopted by geologists.

California has undergone some severe earthquake shocks, of which we commonly talk but little and endeavor to think not at all. Of the modern disturbances, that of 1906 was clearly due to a slip at the surface of the earth along a geological fault line. At the location of this fault the relative slip of the two opposite sides was as much as twenty feet in some places. There is no such evidence available for any other earthquake, but it may be assumed that other shocks in this coastal region were of similar nature.

In Japan, where some five hundred earthquakes of sensible character have been recorded in twenty years, the shocks are presumably not due to slips at the surface along geological faults.

The only extensive results of astronomical observations in this region are those at the Lick Observatory, where meridian circle work has been prosecuted for nearly thirty years, and at Ukiah, about a hundred and fifty miles northwest of us, where zenith telescope work has been carried on continuously for twenty years. There have been isolated zenith telescope determinations of latitude, but they would contribute little of importance to the discussion of progressive or abrupt changes, owing to the uncertain errors of the star declinations adopted.

For instance, the latitude of our instrument, as furnished by the U. S. Coast and Geodetic Survey in the early days, was 37° 20′ 24.48″.

This value is more than a second of arc smaller than the one derived from our meridian circle observations, beginning in 1893. Errors of the old observations, including those of the star declinations, the lack of corrections for latitude variations, and the errors of the geodetic triangulation probably account fully for this difference. It appears not to have been quoted as an illustration of geological change. Possibly it is so large as to be out of bounds. The range of movements under discussion at present is usually from one to five feet. There was a notable earthquake in 1868, possibly due to a fault slip. It would, however, be difficult to assign the proper proportions of a difference of a second of arc to the errors of observation and to the slipping, if the 1868 shock is to be made responsible for its part.

The meridian circle results include the epochs of the earthquakes of 1895, 1903, 1906 and 1911. The first one of these was less intense than the others. The observations at Ukiah include the epochs of the last three.

On request for our data, the results given in the column Observed φ_0 below were originally compiled in quarterly values, the observations of each month having been combined into means of the values of two or three months. The table gives the number of successive quarterly values that make up the respective annual values of φ_0. In the annual φ_0 some of the periodic errors due to declination have been eliminated. There are some gaps in the sequence of observations, one from 1908 to 1912 due to my absence at San Luis, Argentina, for the work of the Carnegie Southern Observatory.

The system of standard stars in use varied from time to time, for special reasons of program and international projects of observation, and in the column of Corrected φ_0 the systematic corrections derived from the various authorities have been applied as far as is possible. The reduction has thus been made to the system of auwers, for which a correction of approximately $+0.1''$ may still be required, to give us the true astronomical latitude of our instrument. The average residual of the last column is two thirds the size of that of the column preceding.

There are more stars in the catalog of Newcomb, and rigorous systematic corrections can not be derived for the extra stars. The latitude results during the use of his system, in the years 1901 to 1904, are nearly $0.1''$ higher than those of the remaining years. Some additional results are included in the last column.

Treated as a consecutive series, from 1893 to 1921, there is no sensible continuous progressive change of latitude from the mean, $37° 20' 25.6''$. To illustrate the effect of abrupt changes at the epochs of earthquakes, the yearly results have been combined in groups, corresponding to each of three shocks. The small differences thus exhibited are such as would be expected, from the accidental errors of the yearly means. The influence of the high point in the series, where the declinations of Newcomb were employed, is felt in the combinations. There will be an apparent progressive rate up to that point and a drop thereafter which are probably fictitious. The mean values of φ_0 preceding 1901 and following 1904 have excluded the effect of the systematic difference due to Newcomb.

The errors in determining the declinations of stars are smaller than those involved in latitudes, since some of the important systematic errors can be eliminated. The probable error of the annual φ_0 is evidently too large to permit the detection of real changes that do not exceed $0.05''$. Differences of $0.1''$ would be anticipated for half the comparisons between separate yearly means, according to the law of distribution of errors, and three differences as large as $0.2''$ might occur in a run of 18 differences.

The following computed latitudes for Ukiah differ from the true values by a systematic constant. The effect of the fourteen month term is eliminated in the mean of any fourteen consecutive monthly values. The effect of the annual term is eliminated in twelve. By taking means of fourteen consecutive values, beginning each series with the first month of a year, each mean below is subject to a correction for two extra months of the annual term—a small constant for all of them. No corrections need be computed for either term in this

method, and no assumption need be made as to the invariability of the coefficients of either term. The means are thus well adapted to show progressive or abrupt changes in latitude. The annual rate is quite precisely the mean rate for all the international zenith telescope stations, +0.005″ per year. A systematic correction to the proper motions, as originally computed for their star list, would account for this common rate. Its application gives the last column of the Ukiah results, and its effect is to diminish the average residual from 0.034″ to 0.027″.

LICK OBSERVATORY LATITUDE

MERIDIAN CIRCLE

Epoch	No.	Obs. φ_0	Corr. φ_0
1894.2	4	25.52″	25.52″
5.2	4	53	53
6.1	3	70	70
7.0	4	46	58
8.0	4	72	57
9.2	4	76	59
1901.1	4	83	74
2.3	4	81	74
3.2	4	74	67
4.1	3	50	47
6.0	4	47	47
7.3	3	....	61
8.0	2	37	42
12.6	4	64	64
13.3	2	50	50
14.5	4	61	61
16.7	4	....	56
17.6	5	50	55
21.6	3	....	77
Mean		25.60	25.59
Av. residual		±0.12	±0.08
Preceding 1903			25.62
Following 1903			.56
Preceding 1906			25.61
Following 1906			.58
Preceding 1911			25.59
Following 1911			.60
Newcomb, 1901 to 1904			25.65
Preceding 1901			25.58
Following 1904			.57

UKIAH, ZENITH TELESCOPE

FOURTEEN MONTH MEANS

Epoch	(φ_0)	Rate
1902.6	12.08″	12.12″
3.6	12	16
4.6	12	15
5.6	11	14
6.6	11	13
7.6	11	13
8.6	09	10
9.6	15	16
10.6	16	16
11.6	16	16
12.6	14	13
13.6	13	12
14.6	19	17
15.6	24	22
16.6	21	18
19.6	16	12
20.6	10	05
Mean	25.14	12.14
Av. residual ±	0.034	±0.027
Preceding 1906	14.107	14.142
Following 1906	153	142
Preceding 1911	14.117	14.139
Following 1911	167	141

Rate +0.005″ per year.

The probable error of a yearly zenith telescope latitude is evidently about one third that of the meridian circle results. There are approximately 3,000 observations per year in the former, and 800 in the latter. Both classes of observations are subject to systematic errors that produce larger errors in the mean results than would be due to accidental errors of observation only. The purely accidental error of a single meridian circle observation of a star is closely ±0.2″. With graduation error, and the error of nadir reading included, the probable error of a single latitude observation is closely ± 0.3″. The single zenith telescope observations have probable errors of about half this size. The same list of stars was used throughout at Ukiah, while the list varies for nearly every year at Lick.

There is no evidence at Ukiah of an abrupt change in latitude at the epochs of the 1906 and 1911 earthquakes. An average difference of 0.04″ would be expected between any two yearly results. Ukiah lies 26 miles east of the 1906 fault line, and Mount Hamilton is 22 miles east. These distances have generally been concluded to be too large to show any indication of movement at the stations. The positions of the faults responsible for the 1903 and 1911 shocks do not appear to be on record.

Without implying anything in the nature of an apology for the quality of modern astronomical work, we must conclude that it is hardly a criterion for such small changes as are at issue in this case. The principle of natural selection, useful as it may have been in the domain of biology, must be used sparingly, if at all, in astronomical results. This does not preclude taking note of systematic errors, for the existence of which there is evidence all too ample for our purpose of as high precision as we can reach.

The differential results of the triangulation of the U. S. Coast and Geodetic Survey, covering many points in the neighborhood of the 1906 fault, appear to furnish a more precise criterion. The closing error of each triangle represents the errors of observation. No one questions the usefulness of this device, nor its validity, for the purpose of deriving the best individual results available. We commonly follow the same process in fundamental astronomical work, when we derive systematic corrections to right ascensions, by closing a cycle of a year of continuous differential results. An apt illustration, also, is the measure of graduation errors. The sum of the errors of the divisions of one circle must be exactly zero, when we arrive at the starting point of the measures, having gone round the circle. The average closing error for primary triangulation work appears to be about two seconds. Its proportional part must be assigned, as accidental error, to any absolute determination of a point, by the triangulation.

The probable error of an observed direction, for primary work, appears to be less than one second of arc. For secondary triangulation it is between one and two seconds, and for tertiary work it may be as much as five seconds.

One should guard against the assumption that the probable errors are small for any special triangle, when its closing error is small. This error is made up of several constituent parts, and they may balance in the sum of their effects; just as we have zeros in any list of residual errors and also have some residuals as large as three or four times the probable error of the individual results.

The following data have been taken from the reports for 1907 and 1910.

The test of changes in position at several miles from the fault line may be assumed to rest on the triangulation net from the base line between *Mocho* and *Mt. Diablo*. This is not a measured base, but has been connected up with the *Pulgas* base, south of San Francisco. The base line is about 36 miles long, and it lies 33 miles east of the fault, with which it is approximately parallel.

The changes of the tabulated latitudes of 41 stations, between measures before and after 1906, have been summarized below. Each group includes points on both sides of the fault at nearly the same distances. On the east side the average change is 0.02″ south, and on the west the average is 0.05″ north. The average of all changes is 0.04″, and all groups show a plus relative displacement for west minus east. The latitude of the center of the base line is 37.7°.

No.	φ	From Fault	Rel. Dis.
7	37.8°	11 miles	+0.03″
8[1]	37.7°	3 miles	+0.07″
12	38.5°	1 mile	+0.09″
10	38.9°	3 miles	+0.11″
4	37.0°	14 miles	+0.03″

The *Mocho-Diablo* base line, being 33 miles from the fault, one second of arc in the observed direction is represented by nearly a foot lineal measure, (0.01″), at the fault line. At 80 miles, a second of arc is represented by two feet. The average displacements of the groups are from two to eight times the lineal measure of a second of arc, at the respective distances. *Farallon* is the only station west of the fault showing a sensible change (0.027″) at a relatively great distance, 22 miles. The change of 2.7 feet is quite precisely twice the lineal measure of a second of arc, at its distance from the base line.

No change of latitude was found for the station, Mount Hamilton. This point is 12 miles southwest of *Mocho,* and at this distance one foot on the surface is represented by over three seconds of arc, in the observed direction. This result would indicate also that there was no sensible change at the date of the 1903 earthquake, unless the station returned to its original position by an almost equally precipitate movement.

These lineal equivalents are of course only true for arcs measured at right angles to the respective lines of sight. But the relative positions of the base line and points along the fault are in general favorable for the measurement of displacements in latitude, especially for the stations between 37° and 38°. *Farallon* lies almost due west from the center of the line, but was not observed from either end, its position being fixed by directions from stations

[1] One omitted, residual ten times the average.

close to the Coast, in the succeeding net of triangles.

The criterion then is whether the directions of the points in the neighborhood of the fault have been measured within accumulated errors of observation of the order of a second of arc. Apparently, for all stations which are close to each other, though distributed on both sides of the fault, any errors in the adopted positions of *Mocho* and *Diablo* would be systematic in their effect upon relative displacements, affecting all stations alike.

In the summations of the changes at the various stations in groups, the computed probable error of a mean displacement is $\pm 0.005''$, or half a foot. Such precision is apparently five times that of the yearly zenith telescope results.

In the astronomical observations, one foot on the surface is closely equivalent to one one-hundredth of a second in latitude. In geodetic triangulation, one foot on the surface is equivalent to one second of arc, in the direction of a point forty miles distant.

On these grounds we may conclude that the precise differential results of triangulation are better tests for very small changes on the surface than astronomical observations of an absolute character.

R. H. TUCKER

LICK OBSERVATORY,
SEPTEMBER 30, 1922

CONSERVATION AND MODERN LIFE[1]

THIS is an age of high pressure living, of seemingly increasing complexity. Our modern civilization is making such insistent demands upon us that unless we counter by equally insistent measures of self-restraint we must be overwhelmed. Am I drawing too dark a picture or using too strong words? Look into your own experience and see if your success has not been due, in part, at least, to your resistance of certain tendencies and demands, or your failure in some particular to your inability or disinclination to combat some urge, external or internal. It is true, of course, that our lives must be shaped by the culture in which we live, but it is equally true that we must do our share in shaping that culture. Mere following the line of least resistance, passive floating with the tide helps neither our civilization, our fellows nor ourselves.

This is an era of conservation. Its spirit is in the air. We are coming to realize more and more that we must conserve our resources if we are to maintain a high place in the present organization of the community. This statement holds true whether we consider our material resources or our immaterial assets, whether we look to the preservation of our own status or to the maintenance of society. It is with this necessity in mind, then, that I venture to call to your attention a few facts and principles upon which we may base our attitude toward the broader aspects of conservation. And because there is just as urgent need for conserving the elements which shall minister to our inner lives and experiences as there is for guarding those resources of more material nature I shall not confine myself strictly to those ponderable and tangible features which are usually grouped under the conservation movement.

Now whether we call ourselves conservationists or conservatives is just now of little moment. We shall find much in common in the two terms and the values they subserve. Do not both of them imply the clinging to and the preservation of all that is best in the heritage which has been bequeathed us? And what a rich heritage that has been! To what a wealth of treasure have we become heirs, whether we count our physical resources or those of spiritual natures and use. But with the conservative spirit there must also be mingled a real progressivism. Conservatism easily becomes reactionism, as progressivism is in danger of becoming radicalism if they are not actuated by a keen sense of balance. We find abundant exemplification of these statements in present day politics and in history, in the wastage of natural resources or in their undue withholding from proper use, in extreme tendencies in social life and customs, whether it be a clinging to the habits of the past or a hasty adoption of the fads of the present.

[1] Presidential address read before the Iowa Conservation Association at the Charles City meeting, July 13, 1922.

That there is real need for the conserving of our material resources no one, I feel confident, will dispute. We may classify these resources as those which subserve the necessities of our physical beings and those which minister to our inner and higher needs. I realize, of course, that no hard and fast line can be drawn between these. There is a sense in which all are necessary, since symmetrical development and well-poised usefulness of the human life can be attained only when all the ministry of nature has been offered and received. There are, however, a few materials which are basic and necessary for bodily existence. Such are the soil, the water supply, the coal and iron reserves, the vegetal and animal kingdoms, together with other less conspicuous but perhaps equally vital components of the earth's structure. Life in any form, much less in the highly complex types, can continue and thrive only where these are abundantly available and are put to constant use. Because of this their intelligent application to the needs of modern living and their equally intelligent reservation for the needs of future generations are alike imperative.

I do not propose to burden you with a mass of statistics but I do wish to present just a few facts and figures to show you how important a matter the careful use and husbanding of our natural resources has become. The soil is, of course, the basis of all wealth and civilization. Upon its intelligent cultivation depends the very life of the people. The United States proper includes 1,937,144,960 acres of land, of which 838,591,774 acres are classed as farm land. About 50 per cent. of this area is under cultivation, or about one fifth of the total acreage of the country. On this one fifth, then, the population must depend in large measure for its sustenance. How careful the tillers of the soil should be that this small fraction is put to its best use. Intensive farming, proper rotation of crops, more intelligent tillage, prevention of soil wastage, both mechanical and chemical, increased use of fertilizers—all means must be utilized if the necessary crop yields are to be maintained. At present the western states and Canada are among the foremost exporters of foodstuffs for other lands. What will happen when our own population demands all the food our farms can produce? What will happen when a still further increased population finds that the farming states can not supply its needs? It will not suffice to say that that day will never come. Unless our farms maintain and increase their yields that day will most surely come to us as it has come to other nations. The means I have already suggested will help to postpone that unfortunate time, and in addition the tillable acreage may be increased by irrigation and drainage, the losses due to injurious insects and mammals and to plant diseases may be lessened by increased knowledge, care and skill, and increasingly intelligent animal husbandry may improve the quality and quantity of our meat and dairy products.

Iowa may be proud of having both the largest acreage of improved land of any state in the Union, about 30,000,000 acres, and also the largest percentage of improved land to total area, nearly 90 per cent. This improved acreage is about one and one half times that of Texas and about two and one half times that of California. While Texas may boast of her oil booms and California of her climate Iowa must nevertheless produce the crops that shall help feed the world, for she is in the center of the richest land of the globe. The yield of the farms of the Union in 1920, including live stock on the farms, was $12,974,461,000 and that of Iowa during the same year was $1,175,504,318, about one twelfth of the total. My point in citing these figures is to emphasize Iowa's importance as a food producer and the necessity of maintaining and raising the high standard already set.

In mineral resources our country is wonderfully supplied. Probably no other land has such wide variety in such great abundance. This places upon us a stewardship of magnificent proportions and the responsibility is increased by the fact that to a degree far beyond what is true of the soil, these resources if once dissipated are gone forever. The field that has just raised a crop of oats may raise an equally good crop of corn next year, but the land from which our coal was mined last winter will never yield another such harvest.

The water which drives the turbines of Niagara may some day repeat its cycle but the gasoline that drove your car to this conference will never serve that purpose again. Yet in face of these facts millions of gallons of oil are used needlessly or are wasted in other ways. It is estimated that for every ton of coal mined thus far one half ton to one and a half tons have been wasted. We all know how carelessly iron products are handled. Machinery is exposed to the weather, tin cans are allowed to rust away, though the tin is worth large sums, and in many other ways there is a constant loss. It has been estimated that our petroleum supplies will be practically exhausted in a quarter of a century, that the available coal resources will be mined out in another hundred years and that perhaps half a century will see the exploitation of the best and most accessible of our iron ores. These estimates are based on productions similar to those of recent years. Should the output largely increase, the periods of availability will be correspondingly shortened. In this connection it may be well to state that mineral production in the United States advanced from a value of nearly $2,400,000,000 in 1915 to a value of over $6,700,000,000 in 1920, an increase of nearly 300 per cent.

In connection with the minerals and their consumption let me call your attention to the great field of service in the improvement of power-saving machinery. It is said that our steam engines utilize only 20 per cent. of the available power in the coal used. Our systems of heating are equally wasteful and must be improved if we or our posterity are not to suffer. It will not do to be thoughtless optimists. We must mingle foresight and prudence with our typical American hopeful front toward the future.

Other resources which must be held in higher esteem and cherished with greater care and foresight are our water supplies, our forests and other timber resources, together with all other beneficial plants and flowers and native animals. I shall only mention these, as they are to be discussed by more able advocates later at these sessions. I may call your attention in passing, however, to the recent news dispatches reporting nearly 400 forest fires in the far west, many of which, no doubt, were preventable, and to recent statements that insects annually destroy a billion dollars' worth of crops, a waste which the native birds would greatly reduce if given a free hand. I wish chiefly to emphasize here the point which I made earlier, that the beauties and creatures of nature which minister to our ethical and esthetic senses are as truly worthy of our care and attention as are these material necessities of which I have spoken. The world would be a cheerless habitation if it contained only iron and coal and oil and similar basic articles, so-called. Our bodies must be cared for, it is true, but are not our minds and our spirits of equal value? Shall we not then care for the things which help them to grow as well as for these others?

This leads me to another thought akin to that with which I began this address. This is an age of high-pressure living. Is it not of even greater importance that we conserve ourselves than that we care for the things of the world about us? Let me dwell for a moment then on this topic. We need to conserve our physical powers—by correct living, by judicious husbanding of all the gifts with which we are blessed, by scornful repudiation of all things which tend to weaken or break down our bodily endowments. They are ours not to waste but to use. Service is one of the pass words of the day. But service demands preparedness, and preparedness means careful training, self-restraint, symmetrical development. Again, we must conserve our mental powers and faculties. Never was there greater need of well-directed judgment, of poise, of balance, of a high sense of personal responsibility. I feel well-nigh heartsick at times at the inaneness and mental vacuity of such a mass of our young people, at their shallowness of thought and feeling, at the seeming lack of any sense of responsibility and obligation to the world in which they live and to generations yet to come. I can only hope that experience will deepen and broaden their minds and make them more fitted to fulfill those duties which must rest upon them. We are passing through a period of revulsion and reaction from the

tension of the past few years, which may account in part for the condition of which I have just spoken. Financially, industrially, politically, socially we are being driven by shifting winds and carried by changing currents. Shipwreck may be avoided, but clear thinking, cool judging, wise acting must be the pilots at the wheel.

Once more, we must conserve our spiritual ideals and attainments. This is no time for narrowness of outlook. If ever there was a time when broadness of vision was demanded it is to-day. I wonder if you realize to what extent intolerance, the backward look, narrow minded conservativeness are dominating or attempting to dominate the spiritual life of the day. This too, doubtless, is a passing wave, a manifestation of the reaction which is affecting other aspects of life. But its tendencies are dangerous. They are destructive rather than constructive. They tend to shut men out from the higher realms of spiritual life and thought rather than to welcome them and to incite them to the greatest attainment. The founders of our faith and the builders of our nation were men and women whose heads were set forward on their shoulders, not backward. They advanced into the unknown and made of it a patrimony for those who followed them. They held fast the freedom they had obtained and persistently aspired for more. Had it not been so, picture to yourselves, if you please, the history of the past three hundred years. If we abate the struggle or lose the winnings they have made, picture for yourselves again, if you please, the history of the future. Broad-mindedness, altruism, charity, faith, compounded with intelligence and a rational appreciation of the temper and needs of the time, these must be components in the lives of the men and women of to-day who are to shape the destinies of to-morrow.

I have attempted very briefly to summarize some of our resources, the dangers of their abuse and our obligation for their careful utilization. I have also tried to make clear our debt to the future, in the necessity of preserving to posterity as much as possible of the splendid gifts which we have received from a bountiful Creator. I have given you an impressionistic sketch rather than a detailed portrait. I am not a prophet of disaster and I fully believe that as new emergencies arise they will be met by new resources. But I do believe that the duty is laid heavily on each of us to do what in us lies to avert or at least to postpone these emergencies and by living hopefully, bravely, carefully and with our faces toward the light of the future, to conserve every resource, material and spiritual, that may contribute to an aspiring and inspiring life.

JAMES H. LEES

IOWA GEOLOGICAL SURVEY,
DES MOINES, IOWA

THE PRESENT SUPPLY OF BIOLOGICAL STAINS

As many requests have been received for information as to where stains can be obtained at present it seems well to publish a brief note listing the various manufacturers and dealers in this line at present.

Frequent inquiries are made concerning Grübler's stains. In this connection it can be said that there are at present on the market some stains of undoubted Grübler origin and others that are reputed to come from this source. There will undoubtedly be longer lists of Grübler's stains to be obtained as soon as it is easier to import them than at present; but as all of the recent investigations on stains point to the equal quality if not superiority of the American stains, there is no need of looking specially for the reintroduction of the German products. For this reason the domestic market conditions are most important at present. To understand these conditions it must be remembered that there are three different classes of concerns to deal with in this matter: (1) the basic manufacturers, (2) the specialists in biological stains and closely related chemicals, and (3) the dealers in general laboratory supplies.

The basic dye manufacturers are of little concern to the biologists, with two exceptions. These two are:

Calco Chemical Co., 136 Liberty Street, New York City.

National Aniline and Chemical Co., 40 Rector Street, New York City.

Both of these have departments that prepare

special dyes for biological purposes. The National Aniline Company puts out an especially long list, so much so that this department of the company deserves to be considered with the specialists in biological stains to be mentioned below. Three other basic manufacturers—Dicks, David and Co., Varick and N. Moore Streets; Heller and Merz, 505 Hudson Street, New York City; McAndrews and Forbes, Camden, New Jersey—have shown a great deal of interest in the work and put on the market certain products that deserve to rank with the biological dyes and are handled by all the concerns mentioned below.

The specialists in biological stains either manufacture their products from the intermediates or else, whenever they know of a good source of some dye, buy it of the basic manufacturers and see that it comes up to their tests. This was and probably still is the function of Grübler and Holburn in Germany. The domestic concerns falling in this list that are at present in the business are:

Coleman and Bell, Norwood, Ohio.
Empire Biochemical Co., 920 Whitlock Avenue, New York City.
Harmer Laboratories, Lansdowne, Pa.
D. H. Pond, Blackstone Bldg., Cleveland, Ohio.
Providence Chemical Co., Providence, R. I.

as well as the Pharmaceutical Division of the National Aniline and Chemical Company, as mentioned above.

The last mentioned concern needs a further word of explanation because of a certain misunderstanding that is prevalent. In some of the earlier tests made by a committee of the Bacteriological Society, National Aniline products were listed, and they rank rather unfavorably. These, however, were the textile dyes, the only ones then sold by this company. The company has since then decided to specialize in biological stains and their present line of stains is entirely different from those mentioned in the earlier report. Another misunderstanding comes from the fact that when the Heyl laboratories failed, Dr. Heyl entered the employ of the National Aniline and Chemical Co., and the latter concern began marketing biological stains. This naturally gave rise to the impression that the National Aniline Co. has taken over the Heyl Laboratories. Such is not the case, however, and the National Aniline line is distinctly different from those previously marketed by the Heyl Laboratories.

The third class of firms mentioned above needs very little mention here because they are quite well known to the biologist. Some of these laboratory supply houses like Central Scientific Co., A. H. Thomas Co., and E. Leitz Co. buy some one line of stains from the specialists in that line and advertise this fact; others buy dyes from the basic manufacturers and sell them as stains under their own name. Among the latter the Will Corporation deserves special mention because in the past they have manufactured stains where necessary and have standardized those that they have bought exactly as done by the specialists listed above. They are at present, however, stopping the manufacture of these products, now that satisfactory American stains are readily obtainable.

This article is published in the hope that it will assist users of stains in understanding the market and buying intelligently. All the concerns mentioned as dealing particularly in this line of business have given the committee hearty cooperation and are doing their best to market a satisfactory line of stains.

H. J. CONN, *Chairman*
COMMISSION ON STANDARDIZATION OF BIOLOGICAL STAINS

LOWERY LAYMON LEWIS

THE death of Dr. Lowery Laymon Lewis, of the Oklahoma Agricultural and Mechanical College and Experiment Station, on September 26, has taken from the institution and the educational circles of the state a faithful worker and scientist whose loss will be keenly felt.

Dr. Lewis was born at Newport, Tennessee, on September 3, 1869. He received the B.S. degree at the Texas Agricultural and Mechanical College in 1893, and the M.S. in 1894 from the same institution. His studies were continued at the Iowa State College and in 1896 was granted the degree of D.V.M. During that year he came to the Oklahoma Agricul-

tural and Mechanical College as professor of veterinary medicine and state veterinarian. In 1899 he also became professor of zoology and experiment station bacteriologist. He gave himself up entirely to his work not only in the departments in which he was interested but to the school as a whole. That he was highly esteemed was manifested by the fact that in 1900, in addition to his other duties, he was made dean of the School of Veterinary Medicine and, in 1913, was also made dean of the School of Science and Literature. During the year 1915 he was made acting president and director of the experiment station. In 1921 he was made dean of the faculty.

Dr. Lewis was for a time a member of the American Association and was a working member of many scientific societies. Although quiet and retiring in personality, he was always ready to do his part in any enterprise of educational value for public welfare.

His research work was directed chiefly toward the diseases and the improvement of the livestock industry. In his earlier work he was much interested in parasiticides, anthelmintics and disinfectants. Later, he carried on a great deal of work toward the prevention and control of hog cholera and the prevention of tuberculosis in livestock. His most recent experimental work has been with the problem of sterility in domestic animals. In this connection he has shown some of the influences of a concentrated protein diet upon the potency of germ cells.

Dr. Lewis was at his best in his work about his laboratory surrounded by his students and associates. His personal interests were the last to be considered and he made it easy, and a source of pleasure, for his associates who worked with him. His own high ideals of service and love for the truth were the source of inspiration for many college generations. Many students went forth from his classroom filled with the love of science and guided by the example of his calm and thoughtful leadership to meet the problems of life with the same determination, standards and ideals that he imparted to them. Mere words can not summarize services such as he rendered to the school and state. He left an inspiration in the field of altruistic endeavor which will always be held in high esteem by his students, friends and colleagues.

JOHN E. GUBERLET
OKLAHOMA AGRICULTURAL
EXPERIMENT STATION

SCIENTIFIC EVENTS

PRECISE STANDARDIZATION OF RADIO FREQUENCIES

THE Bureau of Standards has developed a very precise method of standardization of radio wave lengths and frequencies, which is the fundamental basis of radio measurements in this country. By the process used, the frequency of radio waves is compared with that of an audible musical note. A tuning fork is mounted in such a way that it may be made to control the frequency of an oscillatory circuit. The frequency of another oscillatory circuit operating at much higher frequencies is then compared with it by means of a cathode-ray oscillograph.

This latter instrument consists of the cathode-ray tube, a special kind of vacuum tube in which the narrow stream of electrons is subjected to the action of electric fields applied by the two alternating-current generators. When neither generator is operating, the electrons, impinging on the active screen at the end of the tube, cause a single luminous spot. If one generator is connected, the spot is deflected back and forth along a single line, horizontal or vertical as the case may be, with such rapidity that it appears as a solid line. If both generators are applied simultaneously, the spot oscillates both horizontally and vertically and appears, in general, as a blurred luminous rectangle. If, however, the frequencies of the two generators bear a simple ratio, such as four to one, the spot traverses and retraverses a definite simple path, forming a figure by which the frequency ratio may be recognized. It has been found possible to compare frequency ratios as high as twenty-one to one.

The bureau is at present engaged in the standardization of a high precision standard

wavemeter by this means. A tuning fork of known frequency, approximately 1,000 cycles per second, is used as the basis of the standardization. A low-frequency generator is tuned to successive multiples of this frequency by means of the cathode-ray oscillograph and corresponding settings of the wavemeter are obtained. A third generator is similarly tuned to multiples of these frequencies and thus by successive stages the standardization is extended to include frequencies as high as 5,000 kilocycles (60 meters). It is intended that this wavemeter be used as the basic standard for the standardization of commercial wavemeters.

THE DEVONIAN FOREST AT GILBOA, N. Y.

CONTINUED operations of the New York Board of Water Supply have brought to light 20 to thirty additional specimens of these earliest trees, all of which, by courtesy of the commissioners, have come to the State Museum, with the exception of one specimen presented to the American Museum of Natural History. These great stumps have now been located at three distinct horizons in the sandstones of late Devonian age, at or near Gilboa, and thus indicate the rising and falling of the shore land on which they grew. The botanical interest attached to this extraordinary occurrence is intensified by the fact that no satisfactory solution has been offered of the relationships of these trees, though they have been known for many years. The character of the stumps themselves and such portions of their tissue as remain have not proved a satisfactory clue to their nature, but Winifred Goldring, paleobotanist, has found in their foliation and fructification evidence which has led to the belief that they are seed ferns (Pteridospermophyta), partaking of the character of Lyginopteris and allied forms, but of a simpler organization. That trees of such magnitude, rising to heights of 30 to 40 feet, should appear so abruptly in geological history is sufficient to indicate what a long unobserved record lies back of this majestic plant growth, the oldest of known forests. In due time an effort will be made to reproduce in the State Museum the conditions under which these trees grew on the sloping shores of the Appalachian.

THE BOYLSTON MEDICAL PRIZES

THESE prizes, which are open to public competition, are offered for the best dissertation on questions in medical science proposed by the Boylston Medical Committee. At the annual meeting held in Boston in 1920 a prize of $300 was awarded to an essay entitled "Acute Inflammation of the Nose, Pharynx and Tonsils" by Mr. Stuart Mudd, of St. Louis. For 1922 there is offered a prize of $500 and the Boyston Prize Medal for the best dissertation on the results of original research in medicine, the subject to be chosen by the writer. The Boylston Prize Medal will be added to the money prize only in case the winning essay shows special originality in the investigations detailed. Dissertations entered for this prize must be in the hands of the secretary on or before February 1, 1923.

In awarding these prizes, preference will be given to dissertations which exhibit original work, but if no dissertation is considered worthy of a prize, the award may be withheld. Each dissertation must bear, in place of the author's name, some sentence or device, and must be accompanied by a sealed packet, bearing the same sentence or device, and containing the author's name and residence within. Any clew by which the authorship of a dissertation is made known to the committee will debar such dissertation from competition. Dissertations must be printed or typewritten, and their pages must be bound in book form. All unsuccessful dissertations are deposited with the secretary, from whom they may be obtained, with the sealed packet unopened, if called for within one year after they have been received.

By an order adopted in 1826 the secretary was directed to publish annually the following votes: (1) That the board does not consider itself as approving the doctrines contained in any of the dissertations to which premiums may be adjudged. (2) That, in case of publication of a successful dissertation, the author be considered as bound to print the above vote in connection therewith.

The Boylston Medical Committee is appointed by the president and fellows of Harvard College, and consists of the following physicians: Reid Hunt, M.D., *secretary;* William T.

Porter, M.D., Edward H. Nichols, M.D., Henry A. Christian, M.D., John Warren, M.D. The address of the secretary of the Boylston Medical Committee is Reid Hunt, M.D., Harvard Medical School, Boston, Mass.

ANTI-VIVISECTION LEGISLATION IN CALIFORNIA

THE proposed law prohibiting vivisection in California was defeated at the recent election by an overwhelming majority. Prior to the election the regents of the University of California, by President David P. Barrows, and the board of trustees of Stanford University, by President Ray Lyman Wilbur, issued the statement which follows:

The advance of sanitation, modern medicine and physiology, nutrition, the teaching of biology and the protection of our industries and agriculture all rest on animal experimentation. The control of the epidemic diseases of man and of animals, the management of surgical operations and of childbirth, and the certification of milk, food and water supplies would be impossible without the knowledge gained by such studies. In fact, the present-day protection of the public from diseases, which is vital to our community life, rests on animal experimentation. The University of California and Stanford University are vitally interested in the defeat of this initiative measure, since its passage would be a state-wide calamity.

Not only would it stop the research work now going on in the medical schools, hospitals and laboratories and in the Bureau of Animal Industry, but it would damage the market for most of California's food products and markedly reduce the confidence of visitors coming into the state. If California could not certify to its food and water supplies, could not guarantee protection against contagious diseases, could not provide certified milk, the effect on agriculture and industry in the state would be disastrous. The near collapse of the olive industry, due to the poisoning of a few people in eastern states, and the way in which the industry was saved by the researches carried on in the laboratories of the two universities, indicate the imperative necessity of freedom for the universities in animal experimentation. California food, instead of being looked to as an example of purity, would be shunned.

The initiative measure would make it impossible to test with birds for deadly gases in the mines of the state. It would stop the manufacture of serum for the prevention of hog cholera, the preparation of vaccine for anthrax and the various other products that are required for the protection of our industries in agriculture and that annually save millions of dollars and prevent great mortality among domestic animals. Under the act, operations on various farm animals could be carried on without anesthetics to increase the palatability of foods, but no animals could be used in experimental work if the information obtained is for the benefit of a person or of the human race.

We feel that no worse attack on the welfare of the state and on the right of the universities to seek and teach the truth could be made. Every man, woman and child, every unborn babe, every domestic animal in the state, would be affected if this measure becomes a law. It strikes at all. It is unnecessary special legislation, due to prejudice and misinformation. No one will tolerate cruelty to animals. The present laws of the state are drastic and sufficient to control any abuse. We know that there is no cruelty to animals in the laboratories of the universities. They are in charge of men and women of the highest character who are unselfishly working to better the lot of their fellowmen and to advance the interests of their community and of the state. Anesthetics are always used for animals in the laboratory in exactly the same way that they are used by surgeons in the operating rooms.

We urge upon the citizens of the state the imperative necessity of defeating this initiative measure.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

REDUCED railway rates for those attending the fourth Boston meeting of the American Association for the Advancement of Science (to be held mainly in the buildings of the Massachusetts Institute of Technology, Cambridge, Mass., from December 26 to 30) have been fully granted by all of the railway passenger associations excepting the Transcontinental. Furthermore, in the territory of the last-named passenger association the privilege of reduced rates on this occasion extends westward on Montana lines to points in Oregon and Washington (excepting Portland), by routes through the Missouri River and St.

Paul. The eastern lines of the Canadian Passenger Association have granted this privilege also. The railway fare for any one attending the Boston meeting from authorized points will be a fare and a half for the round trip, on the certificate plan, as in the case of last year's Toronto meeting. From unauthorized points (all in the far west) attractive excursion rates will be available. The preliminary announcement for the Boston meeting will shortly be mailed to all members of the association.

SCIENTIFIC NOTES AND NEWS

ANNOUNCEMENT is made that the Nobel prize in physics for the year 1921 has been awarded to Professor Albert Einstein, of the University of Berlin, and for the year 1922 to Professor Neils Bohr, of the University of Copenhagen. The Nobel prize in chemistry for the year 1921 has been awarded to Professor Frederick Soddy, of the University of Oxford, and for the year 1922 to Professor F. W. Ashton, of the University of Cambridge. The prizes for medicine have not been awarded.

DR. ROYAL S. COPELAND has been elected United States Senator from New York by a very large majority. Dr. Copeland, who has been commissioner of public health for New York City, was professor of ophthalmology in the University of Michigan from 1895 to 1908.

DR. CHARLES P. STEINMETZ, of the General Electric Company, who was candidate for state engineer in New York on the tickets of the socialist and labor parties, received about three times as many votes as the candidate for governor. The vote for Dr. Steinmetz in New York City was 207,138.

DR. WILLIAM H. NICHOLS, chairman of the General Chemical Company, and Dr. John J. Carty, vice-president of the American Telephone and Telegraph Company, have been elected members of the council of New York University.

THE Grasselli Medal, awarded every year by the Grasselli Chemical Company to the author of the best paper presented before the Society of Chemical Industry during the previous year, was presented to W. H. Fulweiler, chemical engineer of the United Gas Improvement Company, of Philadelphia, at the regular meeting of the section at the Chemists' Club, New York, on October 20.

THE Pharmaceutical Society, London, has presented the Hanbury Medal, awarded every two years for the promotion of research in the chemistry and natural history of drugs, to M. Emile Perrot, professor of materia medica in the University of Paris.

DRS. RAMÓN Y CAJAL, of Madrid, and Bernardo Houssay, of Buenos Aires, have been elected honorary members of the Mexican Society of Biology. Dr. E. B. Krumbhaar, of Philadelphia, has been elected a corresponding member.

THE Bavarian Academy of Sciences has elected as corresponding members, Dr. R. Tigerstedt, professor emeritus of physiology at Helsingfors, and Dr. Ramón y Cajal, professor emeritus of histology at Madrid.

DR. FRANK R. LILLIE, of the University of Chicago and chairman of the Division of Biology and Agriculture of the National Research Council for the year 1922-23, will be in residence in Washington from January 1 until about the end of March. During the period before the expiration of his term on June 30, 1923, he will make occasional visits to Washington, but the major portion of his time will be spent in Chicago.

DR. PHILIP S. SMITH, administrative geologist of the United States Geological Survey, has been appointed acting director.

DR. PERCY LONGMUIR, of Sheffield, has been appointed director of research to the British Cast-Iron Research Association.

DR. A. LOEWY, professor of physiology at the University of Berlin, has accepted the charge of the institute for study of the physiology of altitudes recently founded at Davos by the Swiss government.

MR. R. E. PRIESTLEY, of Christ's College, Cambridge University, has been elected a fellow of Clare College. He was a member of Sir Ernest Shackleton's Antarctic Expedition fifteen years ago, and also of Captain Scott's

expedition in 1913. He has published numerous papers dealing with the geology of the Antarctic.

PROFESSOR ARTHUR SMITHELLS, who has held the chair of chemistry at Yorkshire College and Leeds University since 1885, is to retire at the end of the current session and will take up special research work in chemistry in London.

DR. LEON W. PARSONS has resigned as assistant director of the Research Laboratory of Applied Chemistry of the Massachusetts Institute of Technology to accept a position as chief chemist of the Tidewater Oil Company, Bayonne, N. J.

EDUCATIONAL programs of the various institutions offering courses in chemical engineering are to be investigated by a committee of eleven appointed by the council of the American Institute of Chemical Engineers, with a view to standardizing the training required for the degree of Ch.E. The program of the committee contemplates three years' work in obtaining the adoption of recommendations of a previous committee and the publication of a list of approved schools at the end of this period. The committee consists of H. C. Parmalee, *chairman;* five representative educators: Joseph H. James, W. K. Lewis, A. H. White, R. H. McKee and S. W. Parr; and five representative industrialists: C. E. K. Mees, A. D. Little, C. L. Reese, W. C. Geer and W. R. Whitney.

THE *Journal* of the American Medical Association reports that the close of twenty-five years of teaching and research in physiology by Professor H. Zwaardemaker has been celebrated by friends and students at the physiological institute of the University of Utrecht. His contributions to science include additions to our knowledge of the organs of sense, of the transformations of energy, and of the importance of potassium for the automatism of the organs. He is now studying physiologic radioactivity, and how to help the deaf. He was presented with a *feestbundel* of ninety-five scientific articles from international sources, which, with an introductory article describing his life work, form a volume of 591 pages of the Netherlands *Archives of Exact and Natural Sciences*. His portrait was also presented, to be installed in the institute.

THE Pasteur Lecture for 1922 of the Institute of Medicine of Chicago will be delivered by Dr. Jacques Loeb, of the Rockefeller Institute, on Friday, November 24, 1922. Professor August Krogh, of Copenhagen, lectured before the institute on October 27 on "The exchange of substances through the capillary wall, with some applications to pathological problems." Dr. Robert Bárány, professor of otology at the University of Upsala, also addressed the meeting.

IN continuation of the series of illustrated evening lectures given in the Administration Building of the Carnegie Institution of Washington, Dr. T. H. Morgan, research associate in biology and professor of experimental zoology at Columbia University, will speak on November 28 on "The constitution of the hereditary material and its relation to development."

DR. MAYNARD M. METCALF has been speaking at Purdue University, DePauw University, University of Indiana and Butler College during the first ten days of November, discussing research, the origin and future of man, animal distribution and industrial problems from the biological (humanistic) standpoint. He has held also conferences with small groups of persons specially interested in research, either from the standpoint of pupils looking forward to graduate study, or from the standpoint of institutions in their relations to research.

DR. JOSEPH C. BLOODGOOD, of the Johns Hopkins Medical School, addressed the dentists of Boston at a special meeting on November 10, preliminary to the opening of the "National Cancer Week," on "Lesions of the oral cavity."

DR. IRVING LANGMUIR, research physicist with the General Electric Company at Schenectady, will give a series of three lectures at the Carnegie Institute of Technology on November 27, 28 and 29. The lectures will be given to students and executives in industrial and scien-

tific fields in the Pittsburgh district. The subjects of lectures will be: (1) "Electron emission from heated metals"; (2) "Electron emission from thoriated filaments"; (3) "Methods of controlling electron currents in high vacuum."

DR. JAMES EWING, professor of pathology at Cornell University Medical College, New York, delivered the 1922 Mütter lecture on surgical pathology, before the College of Physicians of Philadelphia, on November 1. His subject was "The principles of the radiation treatment of cancer."

HOBART COLLEGE has recently formed a Science Club, the purpose of which is to promote science among the students of Hobart by means of lectures to which the people of Geneva are invited. The first lecture was held on October 31, when Dr. C. E. K. Mees spoke on "The road to wealth."

DR. ROBERT BARANY, professor of otology of the University of Upsala, Sweden, and winner of the Nobel prize in medicine in 1914, gave a two weeks' lecture course and several clinics for eye specialists and neurologists in St. Louis from October 9 to 21. Dr. Bárány was the guest of honor of the American Academy of Ophthalmology and Otology, which held its annual meeting in Minneapolis, last month. Dr. Bárány will give a similar course of lectures in Chicago, Denver, Los Angeles, Houston, Cincinnati, Cleveland, Boston and New York.

THE Huxley lecture on "Evolutionary tendencies in man's body" was given at the Charing Cross Hospital Medical School by Sir Arthur Keith, M.D., F.R.S., on November 8.

THE Netherlands Medical Association has arranged to celebrate the Pasteur centennial at Amsterdam on November 25. Addresses will be made by specialists in medicine, chemistry and microbiologic technic. Dr. A. Calmette, of the Pasteur Institute at Paris, will deliver an address.

A FORMAL university function commemorating the centenaries of both Mendel and Pasteur will be held by St. Louis University on the evening of December 14. The address on Mendel will be delivered by Professor H. S. Jennings and the address on Pasteur by Professor Victor C. Vaughan. The ceremony will be held in the university auditorium.

W. H. WESLEY, for forty-seven years assistant secretary of the Royal Astronomical Society, died on Ocober 27, in his eighty-second year.

THE death is announced of Dr. Alexander Crum Brown, professor of chemistry in Edinburgh University from 1869 until his retirement in 1908.

PROFESSOR A. V. VASSILIEFF, of the University of Petrograd, writes: "Through the death on September 23, 1922, of Dr. Lev Alexandrovitch Tchugaiev, professor of chemistry in Petrograd University and director of the Institute for the Study of Platinum, the science of chemistry has lost a most devoted student. Professor Tchugaiev died at the age of forty-nine years from typhoid fever. The premature death of this energetic scholar possessing great knowledge and a broad mind and whose conduct has been always guided by the high ideal of devotion to science adds a new great loss to so many suffered by Russian science within the few past years. The first studies of Tchugaiev had for their object the groups of terpenes and of camphor as well as optical properties of organic compounds. But his most important researches, published in the *Comptes Rendus*, in the *Journal of the Chemical Society*, in the *Zeitschrift für Anorganische Chemie* and in the *Journal* of the Physico-Chemical Society of Russia, related to the study of complex compounds of cobalt, nickel and platinum. The last years of his indefatigable work were especially devoted to the study of platinum compounds, their electric conductivity, isomerism, etc. Perhaps the most important of all his investigations relate to the coordination theory of Alfred Werner, to the development of which Tchugaiev contributed not a little."

THE one hundred and seventeenth regular meeting of the American Physical Society will be held in Chicago, at the Ryerson Physical Laboratory, on Saturday, December 2. If the length of the program requires it, there will

also be sessions on Friday, December 1. The annual meeting will be held in Boston, December 26 to 30.

THE second annual meeting of the Deutsche Gesellschaft für Vererbungswissenschaft was held in Vienna on September 25-27. A report in *Nature* says that, though technically a meeting of the German society only, in fact the congress was largely international in character, the visitors including representatives from England, America, Italy, Switzerland, Japan, Holland and the Scandinavian countries. Professor R. Wettstein presided, and the opening address was delivered by Professor E. Baur (Berlin). The principal discussions were opened by Professor Goldschmidt (Berlin) on "The Mutation Problem," and by Professor Ruedin (Munich) on "The Inheritance of Mental Defects." Demonstrations were arranged in the zoological laboratory of the university and in the Natural History Museum. Visits were made to the Biologische Versuchsanstalt (where Professor Steinach demonstrated his transplantation experiments in rats and guinea pigs) and to the principal libraries and art galleries in the town. Professor R. Hertwig was elected president for the ensuing year, and the society accepted his invitation to meet at Munich in 1923.

UNIVERSITY AND EDUCATIONAL NOTES

THE Joint Administrative Board of Columbia University and the Presbyterian Hospital has announced that the site for the new medical center has been transferred to the university and the hospital. The land site extends between One Hundred and Sixty-fifth and One Hundred and Sixty-eighth Streets from Broadway to the Hudson River. It is in excess of twenty acres, and is valued at $4,000,000. It is the gift of Mrs. Stephen V. Harkness and Edward S. Harkness. It was also announced that an agreement has been confirmed between the Presbyterian Hospital, Columbia University and Mrs. Harkness, as donor, for the transfer of a fund of $1,300,000 to Columbia University, for the endowment of educational and scientific work in the School of Medicine and the Presbyterian Hospital. An additional $1,000,000 has been given by Mr. Harkness toward the construction of the new Presbyterian Hospital, and $1,000,000 for the school of medicine.

WE learn from the *Journal* of the American Medical Association that the first building for the new University of Rochester Medical School, a laboratory building, will be completed this month. Temporary offices of administration will be established in it. An appropriation of $1,000,000 has been made by the city government for the new municipal hospital, which will adjoin the Strong Memorial Hospital. They will have a combined capacity of 460 beds. The university is to furnish the professional staff and the city the nonprofessional employees, under a contract recently approved.

MR. CHARLES C. SHARP has given $17,000 to the Ohio State University as an endowment fund for the library of the department of chemistry. Mr. Sharp received the degree in civil engineering from the university in 1888.

THE new dairy industry and horticulture buildings at the branch of the University of California College of Agriculture at the University Farm, Davis, were formally dedicated on October 24. The principal addresses were given by President R. A. Pearson, of the Iowa State College, on "Dairy research and education," by Dr. W. H. Chandler, professor of pomology and vice-director of research in the New York State College of Agriculture at Cornell University, on "The outlook of agricultural research," and by President David P. Barrows, of the University of California.

DR. EDSON SUNDERLAND BASTIN, professor of economic geology in the University of Chicago, has been made chairman of the department to succeed the late head, Dean Rollin D. Salisbury.

AT the New York Homeopathic Medical College and Flower Hospital the following appointments are announced: Israel S. Kleiner, Ph.D., dean; Wm. E. Youland, Jr., M.D., head of the department of pathology; Archibald McNeil, M.D., professor of bacteriology; Annis E. Thomson, M.D., instructor in bacteriology; Jenny Drennan, M.D., resident pathologist.

WILLIAM WALDEN RUBEY, B.A., has been appointed instructor in geology by the Yale Corporation, with assignment to Yale College.

DISCUSSION AND CORRESPONDENCE

THE EVOLUTION OF CLIMATES: A REJOINDER

Two articles criticising and disagreeing with the writer's interpretation of the climatic history of the earth, and Dr. F. H. Knowlton's endorsement thereof, have been lately published in the *American Journal of Science*.[1]

Some of these criticisms are based upon misconceptions of the writer's interpretations and others upon a radical difference as to the source of climatic control prior to the modern era.

In "The Evolution of Climates"[2] and in previous publications the following theses are advanced:

(1) That prior to the Modern Era, of complete solar control, a dual control prevailed, in which the heating effects of solar radiation were largely intercepted by a denser and more persistent mantle of clouds than has prevailed since the Pleistocene; and that solar heating effects were principally exercised upon and above the upper surface of this cloud-sphere, and were, therefore, conservative of the lesser source beneath.

(2) That wide variations in the intensity of "The Solar Constant of Radiation" may have occurred during geologic time, but these did not directly affect climates—for the order of the distributions of temperatures and of glaciations were not conformable to solar control.

(3) That during geologic time earth heat was made available by deformations and ruptures of the crust, etc., which from time to time inaugurated activities of great heat liberating potentiality, namely, the erosion of warm crustal materials and the exposure and transformation of radioactive substances.

(4) That upon the partial exhaustion of these increments, the quickly cooling continents frequently reached low temperatures and were glaciated (*a*) in the interiors and easterly sides, as least affected by ocean influences, as in Huronian and Cretacic times; (*b*) under belts or zones of maximum anti-cyclonic circulation, as in Permo-Carboniferous time; and, later, in the final chill of Pleistocene time, under belts of maximum cloudiness and precipitation. That oceans, by reason of high specific heat, stored successive increments of earth heat and fluctuated between narrower limits than continents until Pleistocene time, when they reached glacial temperatures in polar and middle latitudes. At this stage, they ceased to yield sufficient water vapor to maintain the integrity of the previous mantle of clouds in any latitude, and the earth having lost its last available increment of its original or planetary heat, ceased to be a cooling body and became a warming body by direct exposure to and the trapping of solar radiation converted into heat by contact with the surface. That land areas fluctuated through much wider limits or, as approximately fixed by Professor Schuchert, from 110° F. to —60° F., or through 170°, while oceans fluctuated between 85° and 55°.

(5) That in this process of slow and intermittent cooling by the loss of available increments of earth heat, water was a circulating agent of high efficiency, continuously cooling land areas, and, in part, bearing the heat thus derived to the oceans; the other part became latent in water vapor.

The writer does not consider the nebular hypothesis as part of his interpretation of geologic climates and their merging into those of the Modern Era, as indicated by Professor Coleman [*l. c.*, p. 316].

No glaciation is compatible with a warm earth (Professor Coleman, *l. c.*, p. 316) and the writer nowhere claims that it is; on the contrary, he holds that the earth having been screened from solar radiation by clouds, its continents were subject to such climatic variations as the available increments of earth heat were competent to maintain inside the layers of moist air and clouds which its warm oceans were capable of sustaining. Beneath this

[1] Professor A. P. Coleman (5) Vol. 1, No. 4, 315-319. Professor Chas. Schuchert, *ib.*, 320-324. This article is abridged from a rejoinder to these criticisms, which was denied publication in that journal.

[2] Baltimore, 1922.

screen glaciations frequently occurred non-conformable to solar control; all of which, except the last, merged into a non-zonal distribution of milder climates; while the last merged into the zonally distributed climates of to-day distinctly under solar control.

A uniform and steady supply of heat from the earth's interior under the assumed screen of clouds is not held in the theory which Professor Coleman criticises. On the contrary, it is held that this supply was neither uniform nor steady, but highly variable in both supply and exhaustion.

The periods of glaciation as compiled by Professor Schuchert[3] are accepted as marking variation of climate of greater or less extent and severity in various localities and zones throughout known geologic time. None of these can be reconciled with a mild and equable climate controlled by any source or sources of heat and particularly not to a climate controlled by solar energy; for no glaciation has been recorded conformably to solar control. All were non-conformable thereto and contradictory thereof, but they can be reconciled with periods during which the available increments of the internal heat were exhausted to such an extent that land masses in various latitudes cooled below 31° F. The glaciation of tropical latitudes during Permo-Carboniferous time is particularly fatal to any assumption of solar control; for had this, or any other glaciation, been imposed under solar control it would have commenced in polar latitudes and advanced equatorward, and would have retreated poleward. No glaciation has been so laid down and none except the Pleistocene has so receded and given place to a disposition of climates distinctly zonal and as distinctly under solar control; and the fluctuating advances and retreats were at such short intervals that corresponding fluctuations in solar energy could not be reasonably assumed.

The mantle of clouds need be neither supposed nor assumed. It recorded its effects in glaciations and reglaciations in nearly a score of instances, and it recorded its failures in each interglacial epoch and in the present progressive deglaciations. By no other known means could solar energy have been intercepted to such an extent as to permit frequent glaciations of portions of the earth in latitudes which could not have been sufficiently chilled without such interception.

The writer accepts the variability of climates on continental areas from the dawn to the close of geologic time, as presented by Professor Schuchert [*Smithsonian Inst. Report*, 1914, p. 305]. This variability is well established.[4]

It is also well established in Permo-Carboniferous[5] and Pleistocene glaciations that maxima were attained along quite well-defined zonal lines.

Continental temperatures in tropical and in polar regions now vary within the limits of 110° F. and —60° F., or a range of 170° F.; and ocean temperatures range between 85° and 31° F. or through 54° F. It is a reasonable inference that during geologic climates continental temperatures had approximately the same extreme range, but the range of ocean temperatures for the greater part of geologic time, as admitted by Professor Schuchert, was between 85° F. and 55° F., or through 30° F. But it manifestly took from Proterozoic until Pliocene for oceans to pass through these extremes and only in the Pleistocene did oceans of polar and middle latitudes reach the present lower limit, with their extreme range of 54° F. The present extreme range of continental temperatures between tropical and polar latitudes of 170° F. is the same as the annual range in central Canada and Siberia, and the annual range of ocean temperatures in the same latitude is less than one tenth (1/10) of this.

The comparison of the range of ocean temperatures prior to the Pliocene of 30° F. with the present range of 54°, and the ease with which continental temperatures can range within twelve months through 170° F. supports the writer's views regarding geologic climates.

The prime and radical difference between the conclusions of Professor Schuchert and those of the writer are, as to the source of control, namely, that until oceans chilled to the temperatures marked in Pleistocene time, a dual source of climatic control prevailed, and

[3] *Smithsonian Inst. Report*, 1914, 305-306.

[4] Osborn, "The Age of Mammals," pp. 372-3.

[5] Schuchert, *ib.*, 280-282.

this control was distinctly different from the zonal climatic arrangement of to-day, as manifested by the climatic phenomena recorded in Permo-Carboniferous and in Pleistocene times. The greater part of the "plexus of problems of unparallel difficulty" presented in the Permian is involved in the attempts to fit Permo-Carboniferous glaciations and the concurrent climatic phenomena to the unproved assumption of solar control. This is true of all glaciations, and of the reglaciations following interglacial warmth which so distinctly contradict solar control that it is difficult to understand why the assumption of solar control has been held with such rigid orthodoxy. Neither critic meets the prime question of a dual versus a solar control of geologic climates.

MARSDEN MANSON

BERKELEY, CALIFORNIA,
OCTOBER 9, 1922

THE EFFECTS OF CAPTIVITY ON A SEX CHARACTER

LATE last winter I noticed a gravid female in a tank containing European brown trout at the New York Aquarium, and suggested that she be removed and stripped.

As is well known, the males of many salmonidæ, including salmon and most trout, develop a hook on the lower jaw in the breeding season, which is serviceable in their fights at the spawning grounds. Specimens with hooked jaws were therefore selected from the brown trout tank for milt to fertilize the eggs.

Then it was discovered that a hook-jawed individual might be a female. This phenomenon was unknown to us, and as far as we know has never been recorded. But we soon found that we had made no unique discovery, for about the time the brown trout eggs were changing into fry in the hatching troughs, the Aquarium received a visit from Dr. Francis G. Macnaughton of Dunshire, St. Andrews, Scotland, who has experimented largely with European trout. When the writer told him of the females with hooked jaws, he said that in Europe this phenomenon has not infrequently occurred as a result of captivity.

Precisely what effect captivity may have upon the somaplasm to bring about this curious condition, we leave to conjecture; but what a startling biological event it would be if a lioness were to grow a mane and other female animals in captivity developed the secondary sexual characters of the male!

IDA M. MELLEN

THE NEW YORK AQUARIUM

MISUSE OF THE QUESTIONNAIRE

TO THE EDITOR OF SCIENCE: A questionnaire is being mailed to "persons whose addresses are given in the book 'American Men of Science'" to ascertain "what proportion of American men of science are believers in the current religion, what proportion are not," etc. As the questions are in many cases like the famous "Will you leave off beating your mother?" probably the majority of us will ignore them. The bias of the questionnaire is so obvious, it might well be ignored were it not that we shall probably hear before many months that 97 per cent. of American men of science are utterly without religious beliefs, "as shown by a recent careful investigation." Hence I wish to make this early protest against this particular questionnaire and the possibility of drawing any reliable conclusions from the replies received.

HUBERT LYMAN CLARK

OCTOBER 25, 1922

QUOTATIONS

MOTORLESS FLIGHT IN ENGLAND

THE French airman, M. Maneyrolle, won the prize of £1,000 offered by the *Daily Mail*, by a wind flight on October 21 lasting three hours and twenty-two minutes. The notable successes registered during the recent French contests, and especially during the German contests, raised the question whether British fliers could rival the feats of their foreign colleagues, and the offer of a prize of £1,000 by the *Daily Mail* led to the organization, at Itford Hill and Firle Beacon on the South Downs, of the first British gliding contests since the war, which commenced on October 16 and continued through the week. Additional prizes were offered by the Royal Aero Club and others. The entry of British machines and pilots was

very encouraging, there being some two score British fliers, besides foreign aviators, notably the Dutch airman, M. Fokker. A large number of short flights and some quite long flights were made; yet on the whole the results of the meeting were not of a sensational nature until the last day of the meeting. The general conclusion is that British aviators do not fall behind those of Germany, and that it is possible to find suitable arenas in this country for the practice and display of motorless flight. The most notable achievement of the first day of the contest was a thirty-seven-minute glide by M. Fokker, but this was surpassed by a fine flight executed by Mr. F. P. Raynham. This aviator had already taken a place in the front rank of British pilots in the recent air-race round England: he added to his laurels by remaining in the air in a motorless machine for one hour and fifty-three minutes, thus putting himself in the same category as the German record-makers, Martens and Hentzen. But on the last day, Saturday, two world-records were nevertheless established. J. R. Olley went up in a Fokker biplane, and remained in the air with a passenger for forty-nine minutes, while M. Maneyrolle, in a tandem monoplane glider, succeeded in remaining in the air for three hours twenty-two minutes, thus winning the *Daily Mail* prize and beating the previous record, that of Hentzen, by twelve minutes. During the last ninety minutes of his flight, M. Maneyrolle was accompanied by a monoplane glider flown by Squadron-Leader A. Gray, and it was night when the two machines landed within 100 yards of the point from which they started. These competitions on the South Downs will serve as an encouragement to motorless flight in this country, and will help in the accumulation of knowledge and experience on one of the most interesting developments in modern aeronautics.—*Nature.*

SCIENTIFIC BOOKS

The Theory of Functions of a Real Variable. By E. W. HOBSON, Sc.D., LL.D., F.R.S., Sadleirian Professor of Pure Mathematics and Fellow of Christ's College, in the University of Cambridge. Second edition, Vol. 1. Cambridge at the University Press, 1921. Pp. xvi + 671.

Because of the war and relativity, we are at present in a period of increasing scepticism towards so-called established principles and facts. Many still believe, however, that mathematical knowledge, at any rate, is beyond dispute. For these there will be great disappointment in the pages of Hobson. The book reads in places like unconvincing philosophy; and instead of statements made with full personal conviction, we find, at times, conflicting opinions of "authorities"—beings supposed, by some, to be unknown to mathematicians—and inconclusive attempts at mediation. And yet it is on the Theory of Functions of a Real Variable that rigor in Mathematical Analysis depends. The first edition appeared in the course of Zermelo's work on *Wohlordnung*, when mathematicians were just beginning to get their bearings on certain controversial matters; after a lapse of fourteen years, there is the same indecision. Other writers on Real Variables and Point Sets—for example, Hausdorff, Carathéodory and Hahn—adopt a single point of view and proceed joyfully without misgiving. Professor Hobson wants to give a comprehensive report—his book is the most voluminous treatment of the subject—to include historical matter, and to be as fair as possible, "no attempt has been made to give dogmatic decisions between opposed opinions." This wish to be fair makes Professor Hobson exchange, at times, the rôle of mathematician for that of reporter; it has the advantage, however, of making the reader independent of the author—a significant advantage when we observe that even among mathematicians instances are observable of opinions held not on their merits but on the ground of personal and nationalistic associations.

The rôle of the mediator, however, is apt to be a hard one, not only in industrial, but even in mathematical affairs. For fear of being one-sided, he may lose vivacity. Thus we read on page 238 [author's italics], ***"In order that a transfinite aggregate . . . may be capable of being ordered, a principle of order must be explicitly or implicitly contained in the***

norm by which the aggregate is defined. Or again, page 239, " . . . an aggregate has a cardinal number only when it is one of a plurality of equivalent aggregates, distinct from one another." Again, what success can be expected from an attempt to clarify the notion of aggregate by the introduction of a new word, "norm," itself of debatable meaning? Professor Hobson intimates that something must be "universally accepted" to be admitted as mathematical knowledge; but he does not mention the attack made by Brouwer and Weyl upon some of the fundamental theorems in Analysis. Still again, it may be asked, if (page 6) "the justification [for a certain assumption] is to be found in the fact that no contradiction arises in the theory based on it," why is not the multiplicative axiom justified? Zermelo's *Grundlagen* have led to no contradiction.

The present edition is "revised throughout"; "the parts of the subject dealt with in the first five chapters of the first edition have been expanded into the eight chapters of the present volume." This expansion is due chiefly to the recent developments in the Theory of Integration. The theories of Hellinger, Young and Denjoy are also included. The mathematical world owes a debt of gratitude to Professor Hobson for presenting in a smooth, connected exposition a huge mass of research, a considerable part of which is of recent origin.

The style is, on the whole, very lucid, great pains being taken to prepare the reader's mind for the reception of new ideas. However, here and there we find a lack of compactness—witness the proofs that cover pages 97 and 98, and which may be compressed into one tenth of the space by the use of points with rational coordinates. The treatment retains, in part, something of the freshness of a memoir and will thus prove more stimulating, in one way, than treatises written with a constraining finish.

At this late date, strange to say, the definition of cardinal number as given by Professor Hobson is not without an objectionable feature. Russel is right. Professor Hobson's reference to the "degree of plurality" is like saying, "You know what I mean"; it does not make his definition mathematically acceptable.

On page 259 occurs the following statement: "No elaborate theory is required for functions which retain their complete generality, . . . since few deductions of importance can be made from that definition which will be valid for all functions." It may be of interest to remark that this view is rendered untenable in the light of the results to be announced soon in the *Proceedings of the National Academy of Sciences* in a paper by the reviewer, entitled "New Properties of All Real Functions."

HENRY BLUMBERG
UNIVERSITY OF ILLINOIS

Analysis Situs. The Cambridge Colloquium Lectures, Part II, Vol. V. By OSWALD VEBLEN. Published by the American Mathematical Society, 501 West 116th Street, New York. 150 pp., octavo. 1922.

The Cambridge Colloquium lectures on Analysis Situs were delivered in 1916, but the publication having been postponed because of the war, the lectures were completely rewritten before publication, and the resulting book is a treatise on the elements of Analysis Situs. It is furthermore the only modern book on the subject. By a study of this book it is possible to acquire a knowledge of Analysis Situs without going through the many widely scattered memoirs as was formerly the case. Every one interested in Analysis Situs will welcome Professor Veblen's book as an important and useful contribution to the subject. Part I by G. C. Evans on Functionals and their Applications was published in 1918.

H. L. RIETZ

SPECIAL ARTICLES

ZOSTERA MARINA IN ITS RELATION TO TEMPERATURE[1]

IN connection with some work on the temperature control of the geographical distribution of the marine algæ, it seems to be demonstrated that the terms eurythermal and stenothermal apply only to the power of endurance of a wider or narrower range of temperature

[1] Preliminary communication.

without indicating definitely, as least in the case of the eurythermal species, just what temperature limits are vitally concerned with the persistence of the species. An attempt has been made to establish definite temperature zones, to each of which certain species are normal, and to explain the presence of any species, normal to one zone, in a zone of different temperature, by the fact that the invaded zone, as it was designated, has its temperature raised or lowered to that of the normal zone of the species by some agency or condition, local or general, and for a sufficient length of time to allow of the reproductive processes of the invading species to be effectively carried on. This idea has been set forth in an article entitled "Stenothermy and Zone Invasion." (*Amer. Nat.*, Vol. 54, pp. 385-397, 1920.)

In connection with this investigation, it seemed very desirable to attempt to determine the behavior of a group of aquatic plants other than the Algæ and I turned my attention to the marine spermatophytes, popularly known as sea grasses, eel grasses, or grass wrack. The inquiry, at first, was purely statistical, merely assembling what was known of these plants as to their distribution, their times of flowering, and the relation of their distribution and flowering to isothermal lines of temperature, especially to those of the maxima. The results of this inquiry are set forth in a paper entitled "Geographical Distribution of the Marine Spermatophytes" (*Bull. Torrey Bot. Club*, Vol. 47, pp. 563-579, 1920). It seems, from the data available, that out of 34 known species, 26 are stenothermal, *i. e.*, confined to a single zone of temperature of 5° C. amplitude of the maxima; 6 are somewhat eurythermal, occurring in two such zones; and 2 are broadly eurythermal, occupying 3 or more of such zones. Of the last category, *Zostera marina* L., the common eel-grass of the north Atlantic coasts, is the most pronounced and the most puzzling. After assembling such data as were readily available as to season of reproduction in different portions of its range, I ventured to suggest that the normal zone of *Zostera marina* L. must be the North Temperate, whose waters possess a summer temperature of 15° to 20° C., and that the extension of the distribution of this species as far north as the Upper Boreal is due to the effect of insolation upon the shallow, enclosed waters of its habitat in the invaded zones, and, on the other hand, that the invasion southward into the northern portion of the Tropical Zone is possible on account of the seasonal lowering of the temperature of the waters during the winter and spring.

Since I am able to visit the Atlantic Coast only at very infrequent intervals, I appealed to correspondents and to the U. S. Commissioner of Fisheries to assist in determining the exact status of the temperature conditions of the life-history of *Zostera marina* L. The Commissioner promptly and favorably responded and issued instructions to make the collections desired at the stations at Key West, Florida, Beaufort, N. C., and Woods Hole, Mass. At the Key West station, Ezra Stiles, Jr., early demonstrated that *Zostera marina* L. is absent but that the Turtle Grass, *Thalassia testudinum*, is abundant and presents certain problems. With the transfer of Mr. Stiles to an inland station these observations came to an end. At the Beaufort station, Charles Hatsel, and at two very different localities at Woods Hole, R. A. Goffin have made collections monthly or bi-monthly for some seventeen or eighteen months, together with the proper temperature data. I am deeply indebted to these members of the staff of the Bureau of Fisheries for their most valuable and painstaking cooperation.

I, myself, was able to supplement the observations at the stations of the Bureau of Fisheries by collections made at various stations about Narragansett Bay, R. I., in May, June and July of 1921, and Professor Thurlow C. Nelson of the New Jersey Agricultural Experiment Station kindly made collections throughout the year at stations of the Oyster Commission on the coast of New Jersey.

Since *Zostera marina* L. grows in extensive patches, whose individual plants are fairly uniform in behavior, all that is necessary is to gather a fair sized bunch of plants, dry and forward with the proper data. The extensive mass of material accumulated has not been critically gone over as yet, but sufficient exam-

ination has been made to show that it will assist greatly in unraveling the intricacies of the life history of this species from the point of view of morphological changes and their relation to temperature variation. One fact, indeed, is clearly apparent and that is this: the reproductive season begins at 15° C. or very close to it and extends only to 20° C. or closely in its neighborhood. The vegetative processes preceding anthesis and maturing of seed have also fairly narrow, but different, temperature relations, as do also those succeeding the maturing of seed. The active period of growth and reproduction seems to be normally included within an interval of 10° C., *i. e.*, from 10° C. to 20°. During the colder as well as during the warmer periods of the year, according to the particular zone, normal or invaded, *Zostera marina* L. enters into a state of quiescence, total or nearly so, but revives when the proper temperature for vegetative activity of one sort or the other comes again. The material now in my hands as the result of this cooperation seems ample for clearing up these points, and a more detailed report is in preparation.

There seems to be no dependence on a particular period of illumination in the case of the various stages of growth and reproduction —in other words, no photo-periodism in the sense of Garner and Allard. This negation stands out very clearly.

WILLIAM ALBERT SETCHELL
UNIVERSITY OF CALIFORNIA,
AUGUST 23, 1922

THE AMERICAN CHEMICAL SOCIETY

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY

S. E. Sheppard, *chairman*
Robert E. Wilson, *secretary*

Experimental studies of the radiation hypothesis: FARRINGTON DANIELS. The decomposition of nitrogen pentoxide is a favorable reaction for testing deductions from the radiation hypothesis, since it is a unimolecular, gas phase reaction which takes place at room temperature. The influence of the temperature of the walls of the containing vessel and their optical nature have been investigated. Nitrogen dioxide is an important factor in determining its velocity. The influence of various solvents has been studied. The effect of visible and infra red light has been investigated. Experiments have been carried out to determine whether the vessel walls can supply sufficient energy to cause the reaction. A search has been made for the emission of light predicted on the basis of the radiation hypothesis.

Some deductions from statistical mechanics: W. H. RODEBUSH. Marcelin derived an equation for the temperature coefficient of the rate of a chemical reaction which agreed with the empirical Arrhenius equation. Tolman has shown that this derivation was incorrect. A rigorous derivation of a similar equation is given. By combining this equation with the assumptions of the quantum theory a physical basis is obtained for the empirical equation of Dushman, which has been shown to have considerable validity. The equation contains a constant which is characteristic for the molecule involved so that complete validity of the Dushman equation for all different kinds of molecules could not be expected.

The "creepage" corona, a new type of silent discharge: F. O. ANDEREGG and H. E. BOWERS. The effect of a dielectric material in an electric field has been studied by C. W. Rice (*Proc. Am. Inst. Elec. Eng.*, 1917). K. B. McEachron has found that glass rods may increase the yield of ozone (*Purdue Univ. Eng. Expt. Sta. Bull. 7*). A study of their results shows that the action of the dielectric material in the "creepage" discharge is probably partly catalytic. Experiments have been made with a variety of dielectric materials including fragments of ordinary glass, quartz glass and of earthenware, with and without beeswax impregnation; also blue and white flint and of hematite. The effect of these materials upon air and upon carbon monoxide subjected to a silent discharge has been studied under a variety of conditions. Preliminary results are given, strongly supporting the contention that catalytic action and ionic activation are superimposed in this type of discharge.

The effect of container walls on chemical reactions in the corona: F. O. ANDEREGG and K. B. MCEACHRON. In the effort to trace out the causes which contribute to the common lack of reproducibility in results, in the study of chemical reactions in the corona discharge, experiments have been extended over a considerable period of time. The surface of metallic electrodes is disintegrated so that "polarization" and variation in chemical action may result. If a dielectric mate-

rial is placed between the electrodes, the variable effects of internal and surface changes of the dielectric may be superimposed upon the discharge, the result being variable yields. Some of the products of the reactions in the discharge are liable to be absorbed on the walls, the amount absorbed depending upon the condition of the walls. Under certain conditions complete inhibition of the usual reactions results.

A comparative study of the absorption spectra of phenylazophenol derivatives in the visible region of the spectrum: C. S. ADAMS, C. E. BOORD and ALPHEUS W. SMITH. This paper is a continuation of the work previously published by Smith and Boord. The present study includes fifty-seven azoderivatives, fourteen of which have not been previously described. Alkali salt causes a displacement of the absorption band toward the red end of the spectrum, the degree of displacement varying with the solvent medium. Substitution causes displacement toward the longer wave lengths, the order for substitution in the phenyl nucleus being, in ascending scale, para meta ortho and in the phenol nucleus being ortho meta. The nitrophenyl derivatives form an exception to this rule. Weighting of the molecule by substituents follows Nietzki's rule. This is particularly true of the methyl derivatives. For the halogens Cl Br I, symmetry of the molecule seems to have a marked effect upon the absorption. Restoration of the symmetry of azobenzene by substitution of the same group in both para positions produces a marked hypso-chromic effect.

The potentials of silver: Silver halide—halide electrodes in light. Part I: S. E. SHEPPARD and FELIX A. ELLIOTT. Single potentials of an illuminated electrode were measured by the potentiometer compensation method, in a cell composed according to the system:

Light	KBr aq	Dark
Ag, AgBr, x KBr aq	sat.	x KBr, AgBr:Ag or 0.1 N HBr, H_2, Pt

Hence an illuminated electrode could be coupled with an identical unilluminated electrode, or with a standard hydrogen electrode. The following factors in the preparation have to be controlled to secure reproducibility: (1) preparation of the silver surface; (2) halogenizing the electrode; (3) "ripening" the halogenized surface, and aging. With electrodes thus prepared it was found that the potentials, at an illumination of 16 C. M., were reduced as the concentration of bromide was increased, and also by increased bromination in preparing. With constant intensity of light the electrodes rapidly attained a maximum potential, which then fell off (solarization). Repeated intermittent exposure and darkening, up to 160 minutes, showed no noticeable fatigue.

Oxidation potentials of permanganates with other manganese compounds: D. J. BROWN and S. B. ARONSON.

Energy changes in the reduction of quinones: J. B. CONANT and L. F. FIESER. The free energy, total energy and latent heat of reduction of a number of derivatives of benzoquinone, naphthoquinone and anthraquinone have been determined by measuring the oxidation-reduction potential and its temperature coefficient. The free and total energy changes are very different for different types of quinones. The latent heat of reduction is approximately the same for all the quinones measured. A method has been developed for measuring the potential in alcoholic solutions and applied to a number of substances too insoluble to be measured in aqueous solution. The potential of a given quinone is somewhat greater in alcoholic than in aqueous solution but essentially constant in 50, 75 and 95 per cent. alcohol. The potentials in two different solvents are related by an equation involving the solubilities of the oxidized and reduced compounds.

The effect of substitution on the free energy of reduction. I. Benzoquinone derivatives: VICTOR K. LA MER and LILLIAN E. BAKER. The reproducibility and validity of the electro-metric titration method of measuring oxidation-reduction potentials has been established as less than ± 0.2 Mv., when precautions are taken or corrections made for errors, such as removal of H^+ during the reaction, dissolved oxygen, variation in contact potential, etc. (see below). A ground glass stopper makes an excellent junction for titration work, reproducible to ± 0.05 Mv. for dilute HCl against saturated KCl. Measurements on homologous quinones in acid solutions where the activity ratio quinone hydroquinone is unity show that halogen substitution raises, while alkyl substitution lowers the value of $\prod_0$, the normal potential of reduction in the order Cl > Br > None > Methyl > dimethyl > methyl, isopropyl > m dimethoxy > phenylene (napthoquinone).

Electrometric Oxidation—reduction titrations of pure compounds and mixtures: LILLIAN E. BAKER and VICTOR K. LA MER. Calculation and experiment show that complex formation (quinhydrone) in the case of nine substituted quinone-

hydroquinone systems, is not sufficient to cause any perceptible drift in the values of $\prod_0$ at least in acid solution when the latter is determined over a wide range of concentrations by the method of Clark, the concentration of the quinone substances varying between .001 to .003 M. Impurities whose potentials approximate that of the system under examination so closely as to evade detection by differential titration cause pronounced drifts, the extent of which depends upon the amount of impurity present as well as whether the impurity has the higher or lower potential.

Electrometric titrations of silicic acid: WILLIAM STERICKER. Silicic acid was titrated with sodium hydroxide in order to determine what salts it formed. The sol was prepared from recrystallized sodium metasilicate and was carefully purified by dialysis. The pure sol gelled readily. There was no indication of the presence of hydrogen ions or of the formation of any salts. The titration of a sodium silicate solution indicated that this may have been due to polymerization of the acid. Although the first results would indicate that sodium silicate is completely hydrolyzed in dilute solution, titrations with phenolphthalein indicator show this is not so.

Synthesis of urea with the enzyme urease: EDWARD MACK and DONALD S. VILLARS. The reversible action of enzymes has been already shown in several cases, but has never been demonstrated for urease. In the present paper, it is proved beyond any doubt that the equilibrium in the reaction $(NH_2)_2CO + 2H_2O \rightleftarrows (NH_4)_2CO_3$ can be approached from the $(NH_4)_2CO_3$ side, and that the presence of urease hastens very decidedly the attainment of equilibrium. Previous failure to detect the effect was due to (1) starting with too dilute a solution of $(NH_4)_2CO_3$ and (2) not waiting a long enough time for the action, which even in the presence of urease is slow.

The action of urease in the decomposition of urea: EDWARD MACK and DONALD S. VILLARS. From the work of E. A. Werner and others it seems probable that urea in its reaction with water to form ammonium carbonate takes two courses: (1) it forms ammonium cynanate as an intermediate product, which is itself changed to ammonium carbonate; and (2) it forms ammonium carbamate, which is hydrolyzed to carbonate. By a process of elimination, it has been possible, in the present paper, to show that it is the transformation of urea into ammonium carbamate which is catalyzed by the presence of the enzyme. Process (1) is not affected by urease. It proceeds at its normal rate in the presence of the enzyme.

The acceleration of the hydrolysis of mustard gas by alkaline colloidal solutions: ROBERT E. WILSON and EVERETT W. FULLER. A careful series of experiments was carried out to determine the mechanism by which alkaline colloidal solutions, such as those of sulfonated corn oil, so greatly accelerate the removal of mustard gas from contaminated clothing. It was found that these accelerating solutions do not increase the solubility of the mustard gas in the aqueous phase nor the specific rate of hydrolysis, but that in solutions of proper alkalinity they act as carriers of mustard gas. The acid produced by the hydrolysis precipitates out tiny oil globules in the aqueous film adjacent to the liquid mustard gas, and these globules rapidly dissolve unhydrolyzed mustard gas, and are then swept up into the alkaline portion of the solution and redissolved, thus permitting rapid hydrolysis of the mustard gas which they carry. Part of the acceleration is also due to the fact that these colloidal solutions keep the mustard gas spread out in a thin film on the cloth, instead of causing it to draw up into globules, as happens in the presence of solutions of higher interfacial tension.

Hydrogen ion concentration and photochemical reaction velocity: G. S. FORBES and J. C. WOODHOUSE. The speed of photochemical oxidation of quinine by CrO_3 in unvaried concentrations is nearly constant from $0.5NH_2SO_4$ at least to $2.5NH_2SO_4$. Below 0.5N, the order of reaction with respect to hydrogen ion N_H increases. At 0.01N (the lowest concentration practicable) it is about 1 and is rapidly increasing, presumably toward 2 the value of N_H in the dark. Previously $N_{cr\,o_3}$ had been shown, as small concentrations were reached, to increase from 0 to 1, its value in the dark. The conclusion follows that the oxidation is a reaction stage separate from a preceding stage of photochemical sensitization, and slow with respect to it only at low concentrations. Such relations are doubtless more common than suspected.

The inhibition of the photochemical decomposition of hydrogen peroxide solutions: WM. T. ANDERSON, JR., and HUGH S. TAYLOR. (1) The inhibitory effects of 25 typical organic compounds on the photochemical decomposition of hydrogen peroxide solutions have been studied in four definite spectral regions of the ultra-violet; (2) The inhibition by such agents has been asso-